REMARKS

Claims 1-90 are pending. Claims 31-90 have been withdrawn. Independent claims 1 and 16 have been amended. No new matter is believed to be added by these amendments. Claims 2-15 and 17-30 depend from claims 1 and 16, respectively. Dependent claims 3-6, 9, 11, 12, 14, 18-24, 26, 27, and 29 have been amended. No new matter is believed to be added by these amendments.

The specification was objected to as failing to provide proper antecedent basis for claims 14-15 and 29-30. Claims 4 and 19 are objected to for informality. Claims 1-15 are rejected under 35 U.S.C. §112, second paragraph. Claims 1-30 are rejected under 35 U.S.C. §102(b) as being anticipated by, "Combined Ultrasound and Fluorescence Spectroscopy for Physico-Chemical Imaging of Atherosclerosis" by Warren, *et al.* ("Warren"). Claims 1-30 are rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 6,490,476 ("Townsend"). Applicants respectfully requests allowance of all the pending claims in view of the subsequent remarks regarding the above-mentioned independent claims.

I. Claim Amendments

Independent claim 1 has been amended to clarify that the result of the method is a bioluminescent source distribution. To that effect, the first imaging modality has been clarified to be a tomographic imaging modality and the second imaging modality has been clarified to be an optical imaging modality. Independent claim 16 has been similarly amended. Support for these amendments can be found in the detailed description and no new matter is added by these amendments.

Dependent claims 3-6, 9, 11, 12, 14, 18-24, 26, 27, and 29 have been amended to correct antecedent basis in light of the amendments to the independent claims. No new matter has been added by these amendments. Support for these amendments can be found in the detailed description and no new matter is added by these amendments.

II. Objections to the Specification

The Office Action objected to the specification as failing to provide proper antecedent basis for the limitations of claims 14-15 and 29-30 that refer to "registering" an image. The specification describes registering generally at least in paragraphs 10, 13, 14, 37, and 43. Similarly, the Office Action objected to the specification as failing to provide proper antecedent basis for the limitation of claim 15 that refers to landmark based and landmark free based registration methods. Image registration, including landmark based and landmark free based, is a well-established method in image processing and there are many registration techniques that can be readily used or adapted for use in the present methods and systems. Applicants have attached as Exhibit A, an article entitled "Image registration methods: a survey" by Zitova, et al. (2003). Accordingly, the meaning of the registering step is apparent to one of skill in the art in light of the specification as written and the Applicants respectfully request withdrawal of these objections, and allowance of claims 1-30.

III. Objections for Informality

The Office Action objected to claims 4 and 19 as being informal. Accordingly, Applicants have amended claims 4 and 19 to state, "reconstructed *to represent* multiple types" rather than "reconstructed *for* multiple types." (Emphasis added). Applicants respectfully request withdrawal of these objections, and allowance of claims 1-30.

IV. Rejections Under 35 U.S.C. § 112, second paragraph

Claims 1-15, were rejected under 35 U.S.C. § 112, second paragraph, for failing to particularly point out and distinctly claim the subject matter of the invention. The Office Action states on page 3 that claim 1 recited "the reconstructed image volume" and that there was no antecedent basis in the claim. Accordingly, Applicants have amended claim 1 to state, "*first* reconstructed image" rather than "reconstructed image *volume*." (Emphasis added). Applicants earnestly request withdrawal of this rejection, and allowance of claims 1-30.

V. Rejections Under 35 U.S.C. §102(b)

In the Office Action, claims 1-30 were rejected under 35 U.S.C. §102(b) as unpatentable over Warren and claims 1-30 were also rejected under 35 U.S.C. §102(b) as unpatentable over Townsend. A proper rejection of a claim under 35 U.S.C. §102 requires that a single prior art reference disclose each element of the claim. *See, e.g., W.L. Gore & Assoc., Inc. v. Garlock, Inc.*, 721 F.2d 1540, 220 USPQ 303, 313 (Fed. Cir. 1983). The 35 U.S.C. §102 test is the same for a process. Anticipation requires identity between the claimed process and a process of the prior art. The claimed process, including each step thereof, must have been described or embodied, either expressly or inherently, in a single reference. *See, e.g., Glaverbel S.A. v. Northlake Mkt'g & Supp., Inc.,* 45 F.3d 1550, 33 USPQ2d 1496 (Fed. Cir. 1995). Those elements must either be inherent or disclosed expressly. *See, e.g., Constant v. Advanced Micro-Devices, Inc.,* 848 F.2d 1560, 7 USPQ2d 1057 (Fed. Cir. 1988); *Verdegaal Bros., Inc. v. Union Oil Co.,* 814 F.2d 628, 2 USPQ2d 1051 (Fed. Cir. 1987). For anticipation, there must be no difference between the claimed invention and the reference disclosure, as viewed by a person of ordinary skill in the field of the invention. *See, e.g., Scripps Clinic & Res. Found. v. Genentech, Inc.,* 927 F.2d 1565, 18 USPQ2d 1001 (Fed. Cir. 1991). In summary, the single prior art

reference must properly disclose, teach or suggest each element of the claimed invention. Moreover, "every element of the claimed invention must be literally present, arranged as in the claim. … The identical invention must be shown in as complete detail as is contained in the patent claim." *See, e.g., Richardson v. Suzuki Motor Company Co.,* 868 F.2d 1226, 1236 (Fed. Cir. 1989).

A. Warren

Independent claims 1 and 16 were rejected as being anticipated by Warren. However, Warren fails to disclose, teach, or suggest at least Applicants' claimed limitations comprising "*mapping optical properties of the object to the first reconstructed image*; and detecting optical signals emitted from the object using an optical imaging modality to produce *a bioluminescent source distribution, based on the mapped optical properties*" as recited in claim 1, as amended, or "a library of optical properties of the object, *based on data measured previously using an optical imaging modality*; a processor for *mapping the optical properties of the object to the first reconstructed image*; and an optical imaging device for *detecting bioluminescent signals emitted from the object using a second imaging modality to produce a bioluminescent source distribution, based on the mapped optical properties*" as recited in claim 16, as amended. (Emphasis added). Applicants therefore respectfully submit that Warren does not anticipate Applicants' independent claims 1 or 16.

Warren describes a system for merely superimposing a spectroscopy image onto an ultrasound image to provide physical position information for the spectroscopic information. The Office Action cites page 122, column 2, lines 45-47 and Table 1 as teaching a "library of optical properties." These portions of Warren merely point out optical properties. There is no

teaching in Warren of assembling a library of optical properties, much less "a library of optical properties of the object, based on data measured previously using an optical imaging modality," as presently claimed. The Office Action cites page 123, column 1, section B, lines 1-4 as teaching an "optical property" and page 126, column 1, lines 54-58 as teaching "mapping." The Office Action is referring to the "fluorescence power" of Warren as an optical property. "Fluorescence power," however, is not an optical property of the medium containing the light emitting source. As used in the present claims, optical properties are, in the context of bioluminescent source reconstruction, the optical parameters of biological tissues from which an underlying bioluminescent source distribution can be reconstructed. Furthermore, even if "fluorescence power" was an optical property, there is no teaching in Warren of mapping fluorescence power to an image for reconstruction of a fluorescent source distribution. The Office Action refers to the portion of Warren that describes a "combined fluorescence/ultrasound image." This is not mapping optical properties onto a tomographic image for reconstruction of a fluorescence source distribution, Warren merely superimposes one image on top of the other without regard to mapping any optical properties. As stated in Warren page 122, column 1, lines 31-34, "[i]ncorporating catheter position information provided by ultrasound yields calibrated images of arterial chemical composition which can be ***superimposed*** on the physical image." (Emphasis added.) The Office Action cites page 126, column 1, lines 54-58 as teaching producing a bioluminescent source distribution based on mapped optical properties. However, as discussed previously, nowhere in Warren is such a teaching found. Warren constructs two images of the same object, then superimposes the two images into one image. There is no teaching in Warren of the construction of *a bioluminescent source distribution based on the*

mapping of optical properties to a first reconstructed image as claimed. (Emphasis added). Applicants earnestly request withdrawal of this rejection, and allowance of claims 1-30.

B. Townsend

Independent claims 1 and 16 were rejected as being anticipated by Townsend. However, Townsend fails to disclose, teach, or suggest at least Applicants' claimed methods "*mapping optical properties of the object to the first reconstructed image*; and detecting optical signals emitted from the object using an optical imaging modality to produce a *bioluminescent source distribution, based on the mapped optical properties*" as recited in claim 1, as amended, or "a processor for *mapping the optical properties of the object to the first reconstructed image*; and an optical imaging device for detecting bioluminescent signals emitted from the object using a second imaging modality to *produce a bioluminescent source distribution, based on the mapped optical properties*" as recited in claim 16, as amended. (Emphasis added). Applicants therefore respectfully submit that Townsend does not anticipate Applicants' independent claims 1 or 16.

Townsend utilizes CT to provide data for calculating "attenuation correction factors" for use in generating a more accurate PET image. In the CT/PET combination of Townsend, the system utilizes gamma ray photons which travel along straight lines. On the other hand, the present claims are directed to bioluminescent tomography (BLT), which utilizes bioluminescent photons which move along highly zig-zag paths in biological tissues because the scatter coefficient is much larger than in the cases of X-ray CT and PET. Accordingly, image reconstruction is much more difficult in BLT than that in CT/PET and very little can be applied to BLT from PET developments. One skilled in the art could not derive the methods and systems of the present claims from the teachings of Townsend, as evidenced by the fact that in

the BLT literature, PET and CT methods have not been used for bioluminescent source reconstruction at all.

The Office Action cites column 13, lines 22-25 as teaching "mapping" and further states that "it is well known in the art that CT images are mappings of optical properties." Townsend merely teaches generation of "attenuation factors" by CT scan, then the application of these factors (not a "mapping") to PET data. "The CT images are used to generate the attenuation correction factors." See column 13, lines 24-25. To be analogous to the present claims, Townsend would have to map the "attenuation factors" to the CT image, which is counter to the teachings of Townsend and utterly inoperable. The CT image is used to **generate** the "attenuation factors." "Attenuation factors" are not mapped to the CT image.

The Office Action cites column 13, lines 29-32 for teaching producing a bioluminescent source distribution based on optical properties mapped to a first image. As is known in the art, an attenuation factor is a measure of the opacity of a layer of material for radiation transversing it. Townsend merely teaches generating a CT image, determining attenuation factors, taking a PET scan, and applying the attenuation factors to the PET scan to generate a PET image. "These factors are applied after scatter correction to the PET emission data to correct for attenuation, and the PET images are then reconstructed..." See column 13, lines 29-31. There is no mapping of an optical property to the CT image of Townsend and subsequent generation of a bioluminescent source distribution based on the mapped optical properties. Furthermore, for Townsend to teach reconstruction of a bioluminescent source distribution as claimed, Townsend would have to *reconstruct a bioluminescent source distribution* based on the optical properties consistent with the bioluminescent light spectrum, instead of CT-based "attenuation factors," being mapped to

the CT image, which does **not** occur in Townsend. Applicants earnestly request withdrawal of this rejection, and allowance of claims 1-30.

VI. Conclusion

Neither Warren, nor Townsend anticipate, nor would combinations of Warren and Townsend render obvious, any of the pending claims. As the Court noted in *In re Fine*, "dependent claims are nonobvious under section 103 if the independent claims from which they depend are nonobvious." 5 U.S.P.Q.2d 1569, 1600 (Fed. Cir. 1988). Using this same rationale, dependent claims cannot be anticipated if the independent claims from which they depend are not anticipated. Since the Applicants respectfully assert that all the pending independent claims are allowable, all the pending dependent claims are also allowable. Thus, Applicants respectfully request allowance of all the pending claims in view of the previous remarks and amendments. The Examiner is invited and encouraged to contact directly the undersigned if such contact may enhance the efficient prosecution of this application to issue.

A two-month extension of time filing fee for a small entity ($230.00) is enclosed. The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 14-0629.

Respectfully submitted,

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Exhibit A